

What is claimed is:

1. A bioimplantable tissue fixation device, comprising:

an elongate body formed of a biocompatible, bioresorbable material and having an outer surface, a proximal end, a distal end and a longitudinal axis extending therethrough;

an internal cavity extending into the body from an opening in the proximal end of the body, the internal cavity terminating proximal to the distal end; and

at least one opening formed in the outer surface of the body, each of the at least one openings being in fluid communication with the internal cavity such that the internal cavity is able to accept a treatment material for delivery external to the outer surface of the body through the at least one opening.

2. The fixation device of claim 1, wherein the elongate body is a pin adapted to secure bone and/or soft tissue graft.

3. The fixation device of claim 2, wherein the elongate body is constructed of polymers or copolymers formed from monomers selected from the group consisting of lactide; glycolide;  $\epsilon$ -caprolactone; hydroxybuterate; hydroxyvalerate; 1,4-dioxepan-2-one; 1,5,8,12-tetraoxyacyclotetradecane-7,14-dione; 1,5-dioxepan-2-one; 6,6-dimethyl-1,4-dioxan-2-one; 2,5-diketomorpholine; p-dioxanone (1,4-dioxan-2-one); trimethylene carbonate (1,3-dioxan-2-one); alkyl derivatives of trimethylene carbonate;  $\delta$ -valerolactone;  $\beta$ -butyrolactone;  $\gamma$ -butyrolactone,  $\epsilon$ -decalactone; pivalolactone;  $\alpha,\alpha$ -diethylpropiolactone; ethylene carbonate; ethylene oxalate; 3-methyl-1,4-dioxane-2,5-dione; 3,3-diethyl-1,4-dioxan-2,5-dione; and 6,8-dioxabicyclooctane-7-one.

4. The fixation device of claim 1, wherein the elongate body is formed of a polymer or copolymer selected from the group consisting of polylactic acid, aliphatic polyesters, poly(amino acids), poly(propylene fumarate), copoly(ether-esters), polyalkylene oxalates, polyamides, tyrosine-derived polycarbonates, poly(iminocarbonates), polyorthoesters, polyoxaesters, polyamidoesters, polyoxaesters containing amine groups, poly(anhydrides), polyphosphazenes,

polyurethanes, poly(ether urethanes), poly(ester urethane), biosynthetic polymers and combinations thereof.

5. The fixation device of claim 2, wherein the elongate body has a length in the range of about 15 mm to 65 mm.
6. The fixation device of claim 1, wherein at least a portion of the outer surface of the elongate body includes surface features for holding the elongate body in position after it has been implanted.
7. The fixation device of claim 6, wherein the surface features are selected from the group consisting of roughened regions, threads, barbs, hooks, and combinations thereof.
8. The fixation device of claim 1, wherein the outer surface of the elongate body is smooth.
9. The fixation device of claim 1, wherein the outer surface of the elongate body is porous and the at least one opening formed in the outer surface results from a pore matrix extending between the internal cavity and the outer surface.
10. The fixation device of claim 1, wherein the at least one opening communicates with the internal cavity through at least one passageway.
11. The fixation device of claim 10, wherein the outer surface is non-porous.
12. The fixation device of claim 2, wherein the diameter of the pin is in the range of about 1 mm to 10 mm.
13. The fixation device of claim 2, wherein the resorption profile of the pin is in the range of about 12 to 60 weeks.
14. The fixation device of claim 1, wherein the diameter of the internal cavity is in the range of about 0.5 mm to 5 mm.
15. The fixation device of claim 9, wherein the pores have an average pore diameter in the range of about 0.01 mm to 5 mm.

16. The fixation device of claim 1, wherein the treatment material is a biologically active material.

17. The fixation device of claim 16, wherein the biologically active material is selected from the group consisting of tissue fragments, growth factors, proteins, analgesics, antibodies, enzymes, cytokines, glycosaminoglycans, viruses, virus particles, nucleic acids, peptides, isolated cells, platelets, and combinations thereof.

18. The fixation device of claim 1, wherein the treatment material is an adhesive agent.

19. The fixation device of claim 18, wherein the adhesive agent comprises an anchoring agent selected from the group consisting of hyaluronic acid, fibrin glue, fibrin clot, collagen gel, gelatin-resorcin-formalin adhesive, mussel-based adhesive, dihydroxyphenylalanine (DOPA) based adhesive, chitosan, transglutaminase, poly(amino acid)-based adhesive, cellulose-based adhesive, synthetic acrylate-based adhesives, platelet rich plasma (PRP), Matrigel, Monostearoyl Glycerol co-Succinate (MGSA), Monostearoyl Glycerol co-Succinate/polyethylene glycol (MGSA/PEG) copolymers, laminin, elastin, proteoglycans and combinations thereof.

20. The fixation device of claim 18, wherein the adhesive agent comprises a chemical cross-linking agent selected from the group consisting of divinyl sulfone (DVS), polyethylene glycon divinyl sulfone (VS-PEG-VS), hydroxyethyl methacrylate divinyl sulfone (HEMA-DIS-HEMA), formaldehyde, glutaraldehyde, aldehydes, isocyanates, alkyl and aryl halides, imidoesters, N-substituted maleimides, acylating compounds, carbodiimide, hydroxychloride, N-hydroxysuccinimide, light, pH, temperature, and combinations thereof.

21. The fixation device of claim 10, wherein the at least one opening formed in the outer surface of the body includes a number of openings in the range of about 5 to 25.

22. The fixation device of claim 10, wherein the diameter of the at least one opening is in the range of about 0.5 mm to 1.5 mm.

23. The fixation device of claim 1, wherein the elongate body has a substantially cylindrical shape.

24. The fixation device of claim 1, wherein the distal end of the elongate body tapers to a point.

25. A method for attaching a tissue graft to bone, comprising:

forming a bone tunnel into bone;

providing a tissue fixation device in the form of an elongate member having a longitudinally oriented channel formed therein that extends from an opening in a proximal end thereof, the tissue fixation device having at least one opening formed in a sidewall thereof that is in fluid communication with the channel;

positioning a portion of the tissue graft within the bone tunnel;

inserting the tissue fixation device within the bone tunnel to secure the tissue graft therein;  
and

injecting a treatment material into the channel of the tissue fixation device to enable the material to be secreted through the at least one opening to a region external to the sidewall of the tissue fixation device.

26. The method of claim 25, wherein the treatment material is a biologically active material.

27. The method of claim 26, wherein the biologically active material is selected from the group consisting of tissue fragments, growth factors, proteins, analgesics, antibodies, enzymes, cytokines, glycosaminoglycans, viruses, virus particles, nucleic acids, peptides, isolated cells, platelets, and combinations thereof.

28. The method of claim 25, wherein the treatment material is an adhesive agent.

29. The method of claim 28, wherein the adhesive agent comprises an anchoring agent selected from the group consisting of hyaluronic acid, fibrin glue, fibrin clot, collagen gel, gelatin-resorcin-formalin adhesive, mussel-based adhesive, dihydroxyphenylalanine (DOPA) based adhesive, chitosan, transglutaminase, poly(amino acid)-based adhesive, cellulose-based

adhesive, polysaccharide-based adhesive, synthetic acrylate-based adhesive, polyurethane-based adhesive, platelet rich plasma (PRP), platelet poor plasma (PPP), Matrigel, Monostearoyl Glycerol co-Succinate (MGSA), Monostearoyl Glycerol co-Succinate/polyethylene glycol (MGSA/PEG) copolymers, laminin, elastin, proteoglycans, and combinations thereof.

30. The method of claim 28, wherein the adhesive agent comprises a cross-linking agent selected from the group consisting of divinyl sulfone (DVS), polyethylene glycon divinyl sulfone (VS-PEG-VS), hydroxyethyl methacrylate divinyl sulfone (HEMA-DIS-HEMA), formaldehyde, glutaraldehyde, aldehydes, isocyanates, alkyl and aryl halides, imidoesters, N-substituted maleimides, acylating compounds, carbodiimide, hydroxychloride, N-hydroxysuccinimide, light, pH, temperature, and combinations thereof.